Field Test Program for Long-Term Operation of a COHPAC System for Removing Mercury from Coal-Fired Flue Gas

Quarterly Technical Report
Reporting Period: April 1, 2003 – June 30, 2003

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Submitted: July 30, 2003

DOE Cooperative Agreement No.: DE-FC26-02NT41591

Report No. 41591R04

DISCLAIMER

ABSTRACT

With the Nation's coal-burning utilities facing the possibility of tighter controls on mercury pollutants, the U.S. Department of Energy is funding projects that could offer power plant operators better ways to reduce these emissions at much lower costs. Sorbent injection technology represents one of the simplest and most mature approaches to controlling mercury emissions from coal-fired boilers. It involves injecting a solid material such as powdered activated carbon into the flue gas. The gas phase mercury in the flue gas contacts the sorbent and attaches to its surface. The sorbent with the mercury attached is then collected by the existing particle control device along with the other solid material, primarily fly ash.

During 2001 ADA Environmental Solutions (ADA-ES) conducted a full-scale demonstration of sorbent-based mercury control technology at the Alabama Power E.C. Gaston Station (Wilsonville, AL). This unit burns a low-sulfur bituminous coal and uses a hot-side electrostatic precipitator (ESP) in combination with a Compact Hybrid Particulate Collector (COHPAC) baghouse to collect fly ash. The majority of the fly ash is collected in the ESP with the residual being collected in the COHPAC baghouse. Activated carbon was injected between the ESP and COHPAC units to collect the mercury.

Short-term mercury removal levels in excess of 90% were achieved using the COHPAC unit. The test also showed that activated carbon was effective in removing both forms of mercury: elemental and oxidized. However, a great deal of additional testing is required to further characterize the capabilities and limitations of this technology relative to use with baghouse systems such as COHPAC. It is important to determine performance over an extended period of time to fully assess all operational parameters.

The project described in this report focuses on fully demonstrating sorbent injection technology at a coal-fired power generating plant that is equipped with a COHPAC system. The overall objective is to evaluate the long-term effects of sorbent injection on mercury capture and COHPAC performance. The work is being done on one-half of the gas stream at Alabama Power Company's Plant Gaston Unit 3 (nominally 135 MW). Data from the testing will be used to determine:

1. If sorbent injection into a high air-to-cloth ratio baghouse is a viable, long-term approach for mercury control; and
2. Design criteria and costs for new baghouse/sorbent injection systems that will use a similar, polishing baghouse (TOXECON) approach.

TABLE OF CONTENTS

LIST OF GRAPHICAL MATERIALS

There are no graphical materials included in this report.

EXECUTIVE SUMMARY

ADA-ES began work on a Cooperative Agreement with the Department of Energy in September 2002 to fully evaluate Activated Carbon Injection (ACI) in conjunction with a high-ratio baghouse (COHPAC) for mercury control. The work is being conducted at Alabama Power Company's Plant Gaston. During the two-year project, a powdered ACI system will be installed and tested at the plant for a continuous one-year period of time. ADA-ES is responsible for managing the project including engineering; testing, economic analysis, and information transfer functions.

During the fourth reporting quarter, April through June 2003, progress on the project was made in the following areas:

- Initial baseline tests were completed. Ontario Hydro measurements were made for mercury at the inlet and outlet of Unit 3B COHPAC. Continuous mercury measurements were made with the on-site Semi Continuous Emission Monitor (S-CEM).
- Initial optimization tests with activated carbon were completed.
- Due to significantly different baseline performance compared to previous tests, a second baseline period was conducted and completed during this reporting period.

INTRODUCTION

Cooperative Agreement No. DE-FC26-02NT41591 was awarded to ADA-ES to demonstrate Activated Carbon Injection (ACI) technology on a coal-fired boiler equipped with a COHPAC baghouse. Under the contract, ADA-ES is working in partnership with DOE/NETL, Alabama Power and EPRI.

A detailed topical report will be prepared at the end of the one-year test period. Quarterly reports will be used to provide project overviews and technology transfer information.

Team Members

This program is made possible by significant cost share support from the following companies:

- EPRI
- Southern Company and Alabama Power Company
- Hamon Research-Cottrell, Inc.
- Alleghany Power
- Ontario Power Generation

- TVA
- Arch Coal, Inc.
- ADA-ES

A group of highly qualified individuals and companies was assembled to implement this program. Project team members include:

- ADA-ES
- Southern Research Institute
- Grubb Filtration Testing Services, Inc.
- Reaction Engineering International

EXPERIMENTAL

Activated Carbon Injection Equipment

The activated carbon injection equipment was installed, field-tested, and continues to operate.

Mercury Analyzer

The mercury analyzer is operating and measuring total vapor-phase mercury at the inlet and outlet of the COHPAC baghouse.

A full equipment description can be found in the previous report, DOE Report No. 41591R03.

RESULTS AND DISCUSSION

Baseline Test Period 1 (March 24 – April 21)

A baseline period was planned to gather operating performance data of the COHPAC baghouse, and to measure mercury at the inlet and outlet of COHPAC under normal operating conditions. Coal and ash samples were also collected during this period.

<u>COHPAC Performance</u>

At Gaston, the primary variable used to track COHPAC performance is cleaning frequency. The cleaning logic is set to begin a clean at a specified pressure drop/drag set-point. There was a noticeable change in cleaning frequency before and after the spring outage, which concluded just before the start of the baseline tests. Prior to the outage, average cleaning frequency varied between 1 and 2 pulses per bag per hour. After the outage, the average cleaning frequency was often above two, with periods of continuous cleaning (4 pulses per bag per hour). This presented a problem because adding carbon to the baghouse would increase cleaning frequency further. It was believed that the high cleaning frequency was caused by burning certain coals.

Inlet loading to COHPAC is measured with a BHA Particulate Monitor. Particulate loading on the 3B side during baseline varied from a low near 0.025 gr/dscf to nearly 0.2 gr/dscf. This can be seen in Figure 1, which is a printout from the COHPAC computer during a portion of the baseline test. The lower line in the top graph shows inlet loading. In the same figure, the lower line in the middle graph is cleaning frequency. As would be expected, inlet loading has a direct impact on cleaning frequency.

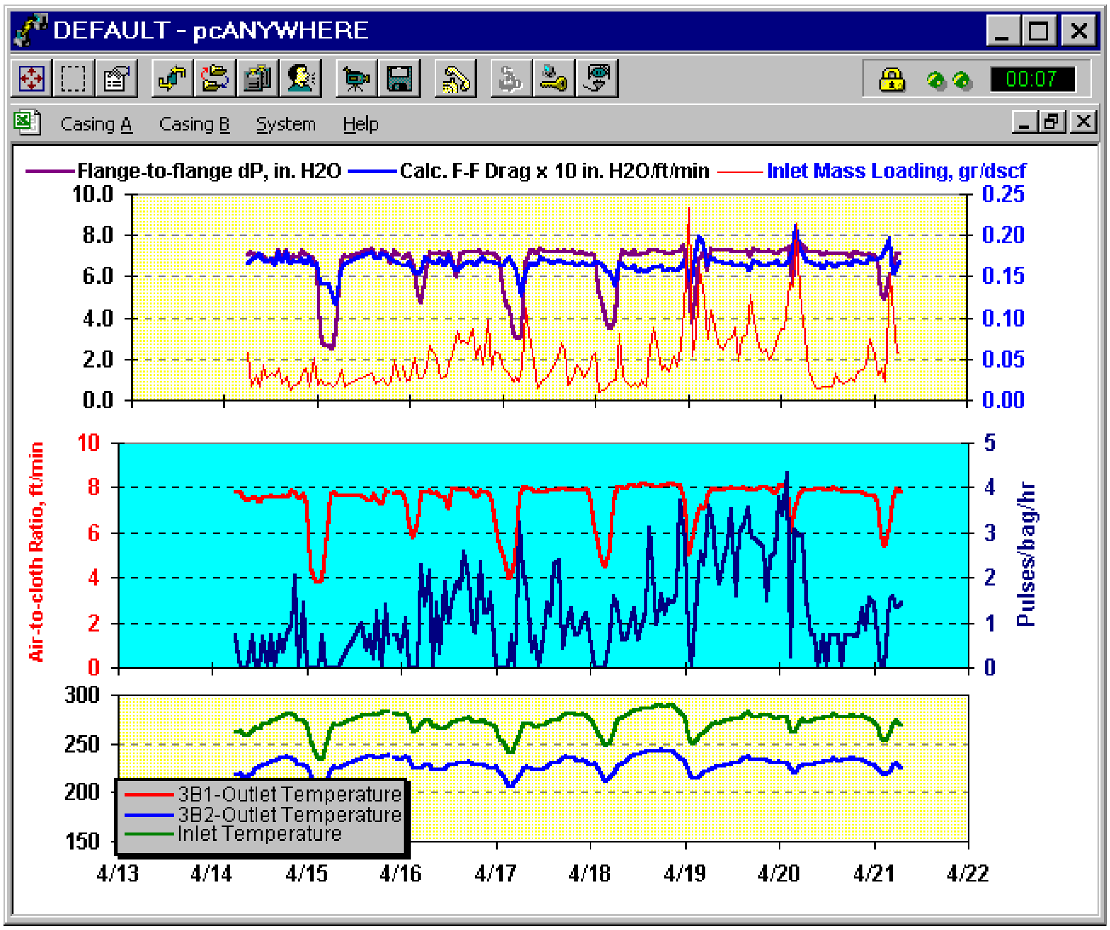

Figure 1. Printout of Unit 3B COHPAC operating trends (April 13 – 21)

Mercury Measurements

Weston Solutions, Inc., conducted Ontario Hydro measurements for total mercury on April 1, 2, and 3. Manual measurements for HCl and multi-metals (Method 29 at outlet only) were also made at this time. Continuous total vapor-phase mercury was measured at the inlet and outlet of Unit 3B COHPAC with the on-site S-CEM on working days, Monday through Friday.

S-CEM Mercury Measurements

The mercury analyzer was in operation during this period measuring total vapor-phase mercury. The analyzer was set to alternately measure at the inlet and outlet with approximately 10 samples at each location. The analyzer was operated during the week and shut down over the weekend. Data from the baseline period are shown in Figure 2. The top graph presents inlet and outlet mercury concentrations, the second graph presents calculated mercury removal efficiency, and the third and fourth graphs are data collected by the COHPAC computer for cleaning frequency and boiler load. Figure 2 shows:

- Over the nearly 5-week baseline period, inlet mercury varied between nominally 7 and 18 $\mu g/Nm^3$. This is similar to variations seen during the Phase I tests.
- Outlet mercury varied between nominally 1 and 18 $\mu g/Nm^3$, with mercury removal efficiencies varying between 0 and 90%. This was certainly not what was seen in Phase I, where baseline S-CEM measurements showed very little, if any, mercury removal.
- Often, higher mercury removal efficiencies could be correlated to periods of high cleaning frequencies. This relationship can be seen in Figure 2.
- Note – mercury concentrations corrected to 3% oxygen.

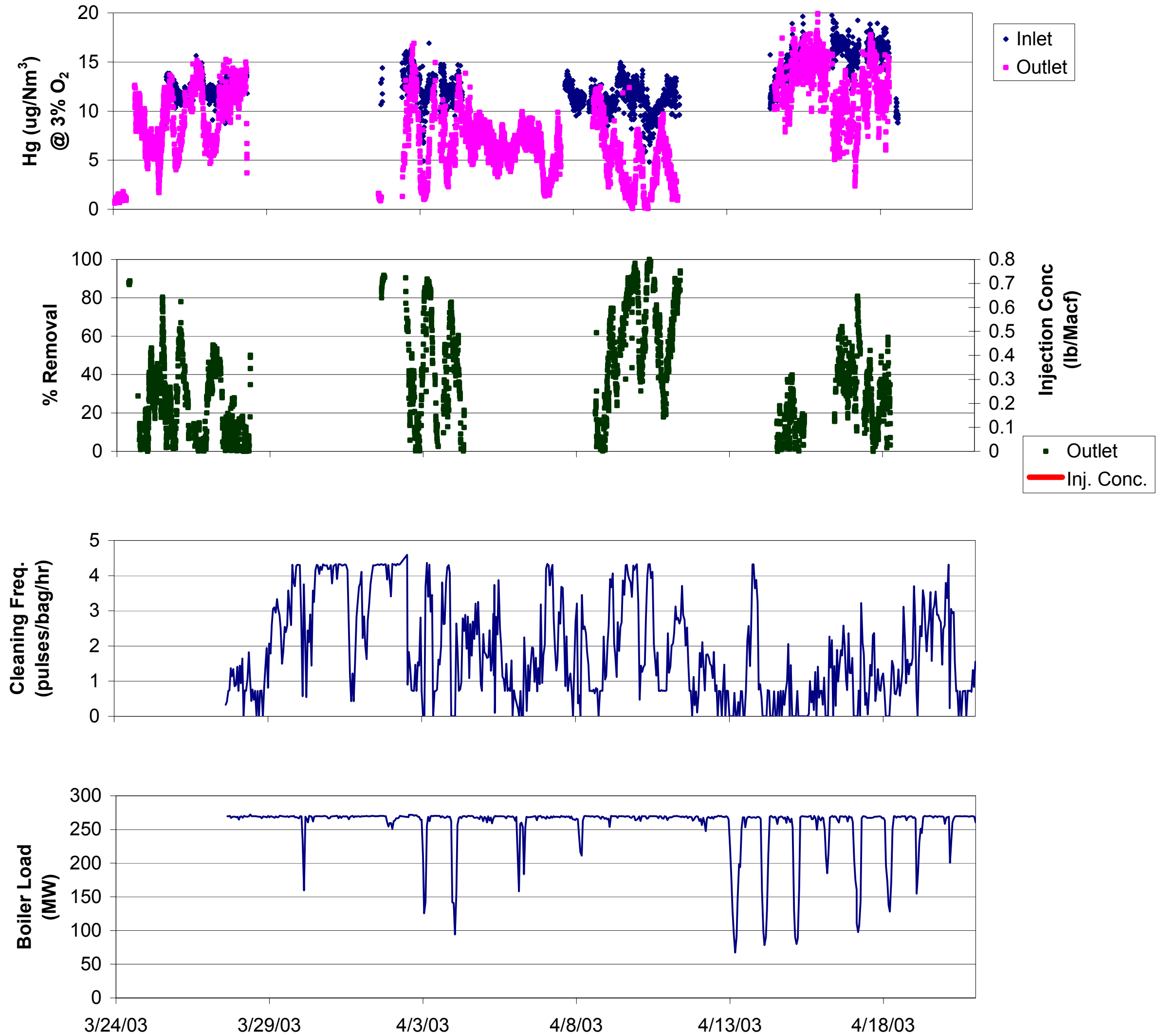

Figure 2. Unit 3B performance and operating trends during baseline test period.

Ontario Hydro Mercury and HCl Measurements

Results from the Ontario Hydro measurements including speciated mercury concentrations for each of the three runs at the inlet and outlet, corresponding removal efficiencies, and averages from the three runs are presented in Table 1. In summary:

- Inlet mercury varied between 15.6 and 19.5 µg/Nm^3.
- Outlet mercury varied between 11.8 and 15.1 µg/Nm^3.
- For the individual runs, mercury removal efficiency varied from nominally 5 to 39%.
- On average there was 26.3% mercury removal across the COHPAC baghouse. In the Phase I tests, average baseline mercury removal was 0%.
- At the inlet, 64.4% of the mercury measured was oxidized, 27.5% was elemental and 8.2% was particulate.

- At the outlet nearly all of the mercury, 92.0%, was in the oxidized form.
- Average HCl in the flue gas from three runs was 5.5 ppm.
- Results from Method 29 Multi-Metals tests are still being reviewed.
- Note – mercury concentrations were corrected to 3% oxygen.

Table 1. Results from Baseline Testing Series w/out Sorbent Injection – Gaston Unit 3B COHPAC April 2003 (all mercury measurements in ($\mu g/Nm^3$) and corrected to 3% O_2)

Location	Particle Bound	Oxidized Hg^{2+}	Elemental Hg^0	Total, Hg
Inlet – Run 1	2.6	10.4	4.2	17.2
Outlet – Run 1	0.05	10.7	1.0	11.8
RE (%) Run 1				**31.4**
Inlet – Run 2	1.2	13.4	5.1	19.5
Outlet – Run 2	0.02	11.1	0.8	12.0
RE (%) Run 2				**39.0**
Inlet – Run 3	0.57	10.2	5.2	15.6
Outlet – Run 3	0.09	13.9	1.1	15.1
RE (%) Run 3				**5.3**
Average Values				
Inlet	1.4	11.3	4.8	17.6
Outlet	0.05	11.9	0.99	13.0
RE (%)	**96.3**	**-5.4**	**79.6**	**26.3**
% of Total Inlet	8.2	64.4	27.5	
% of Total Outlet	0.4	92.0	7.6	

Ash and Coal Measurements

During Baseline Period 1 testing, coal samples were collected daily during the week and ash samples were collected periodically from both the A- and B-side COHPAC hoppers and from the hot-side ESP hopper. A complete list of samples collected during this period can be found in the Appendix.

Optimization Test Period 1 (April 22 – May 27)

The optimization period was planned to determine the optimum carbon injection concentration that would meet mercury removal targets (90%); result in cleaning frequency less than continuous, but up to 3 pulses per bag per hour; and have sufficient margin so that this injection concentration could be maintained over a four- to six-month period. The original plan, including target injection rates and removal efficiencies, had to be modified because of higher baseline cleaning frequencies and mercury removal. A revised plan was developed and is presented in Table 2. Testing during this period included COHPAC performance monitoring, mercury S-CEM measurements and ash/coal sampling.

Table 2. Revised test plan for Optimization Period 1 (original bags)

Test Period	Duration	Injection Concentration (lbs/Macf)	Injection Rate (lbs/h)
Week 1	2 days	0.7	20
Week 1	2 days	0.35	10
Week 2	Begin continuous injection (24/7)	TBD	TBD
Week 3 – End	Continuous Injection	TBD	TBD

On Tuesday April 22 carbon injection was started at an injection concentration of 0.70 lbs/Macf (20 lbs/h). On Wednesday April 23 the rate was lowered to 0.35 lbs/Macf (10 lbs/h) because of high cleaning frequency. Cleaning frequency did not improve when the injection rate was lowered; however, shortly after this change in feedrate, boiler load decreased to a very low level and cleaning frequency recovered. Per the test plan, carbon injection was stopped after a few days to evaluate the data and decide on the condition for the following week. The following week, carbon injection was started at a concentration of 0.35 lbs/Macf (10 lbs/h) and the system operated at this rate until Tuesday May 27.

Mercury Measurements

The mercury analyzer was in operation during this period measuring total vapor-phase mercury at the inlet and outlet. The analyzer was operated during the week and shut down over the weekend.

S-CEM Mercury Measurements

- Figure 3 presents data from first week of the optimization test period. These graphs show inlet and outlet mercury concentrations, removal efficiency, carbon injection concentration, Unit 3B cleaning frequency and Unit 3 boiler load. Carbon was injected for three days at two different rates; this can be seen as the solid line in the second graph from the top.
- Outlet mercury levels can be seen to vary significantly prior to starting carbon injection on April 22. Once injection began, outlet mercury levels were less than 2.5 $\mu g/Nm^3$. Removal efficiency was greater than 80% during this period, regardless of the injection rate. A decrease in removal efficiency can be seen when the rate was decreased on April 23, but it quickly returned to a higher level.
- Figure 4 presents optimization test data from April 22 through May 23. Based on results from the first week, carbon injection was started at a low rate of 0.35 lbs/Macf (10 lbs/h) on April 29. Injection was maintained at this rate until May 27.
- During this period, removal efficiency varied between 55 and 95%. At this low rate and with varying baseline mercury removal, it is not surprising to see such a large variation in removal efficiency. Carbon injection did change the lower boundary of removal efficiency to at least 55%, instead of varying between 0 and 90%.
- Note – mercury concentrations corrected to 3% oxygen.

COHPAC Performance

COHPAC Performance

- Cleaning frequencies on both sides continued to be higher than historical averages. Both Alabama Power personnel and individuals from this test team investigated the cause of this higher cleaning frequency. It is believed that the higher loading to COHPAC occurs with certain coals. One day in particular backs this theory. On Monday April 28 the baghouse was in continuous clean and mercury removal was high. The control room operator on duty pointed out that the mills were working harder than usual. At this same time we checked the electrical conditions of the hot-side ESP. All fields were in service and the ESP was operating within expected values. However, the loading to COHPAC was near 0.2 gr/dscf. Ash samples were taken and they were very dark. In this condition, there was a higher percentage of unburned carbon exiting the boiler. It appears that this carbon was passing through the ESP at a higher rate than normal fly ash. Near the end of the day, the coal supply changed and COHPAC cleaning frequency returned to a more normal level.
- Analyzing data from week 1 parametric tests shows that when injection concentration was lowered from 20 to 10 lbs/h (0.7 to 0.35 lb/Macf), cleaning frequency did not change (see Figure 3). Inlet loading during this period was very high, up to 0.2 gr/dscf. Cleaning frequency did improve with lower load and remained lower when load was raised. After the load drop, inlet loading as measured by the BHA was also much lower, <0.05 as compared to near 0.2 gr/dscf.
- Cleaning frequency for weeks 2 and 3, when carbon was injected continuously at 0.35 lbs/Macf (10 lbs/h), is higher than expected. At this injection rate, Phase I tests would have predicted an increase in cleaning frequency of about 0.5 p/b/h (pulses/bag/hour). During this period the inlet loading again was variable, with readings up to 0.2 gr/dscf. At an injection rate of 10 lbs/h and an inlet temperature of 250^{o}F, we are adding about 0.003 gr/scf in carbon.

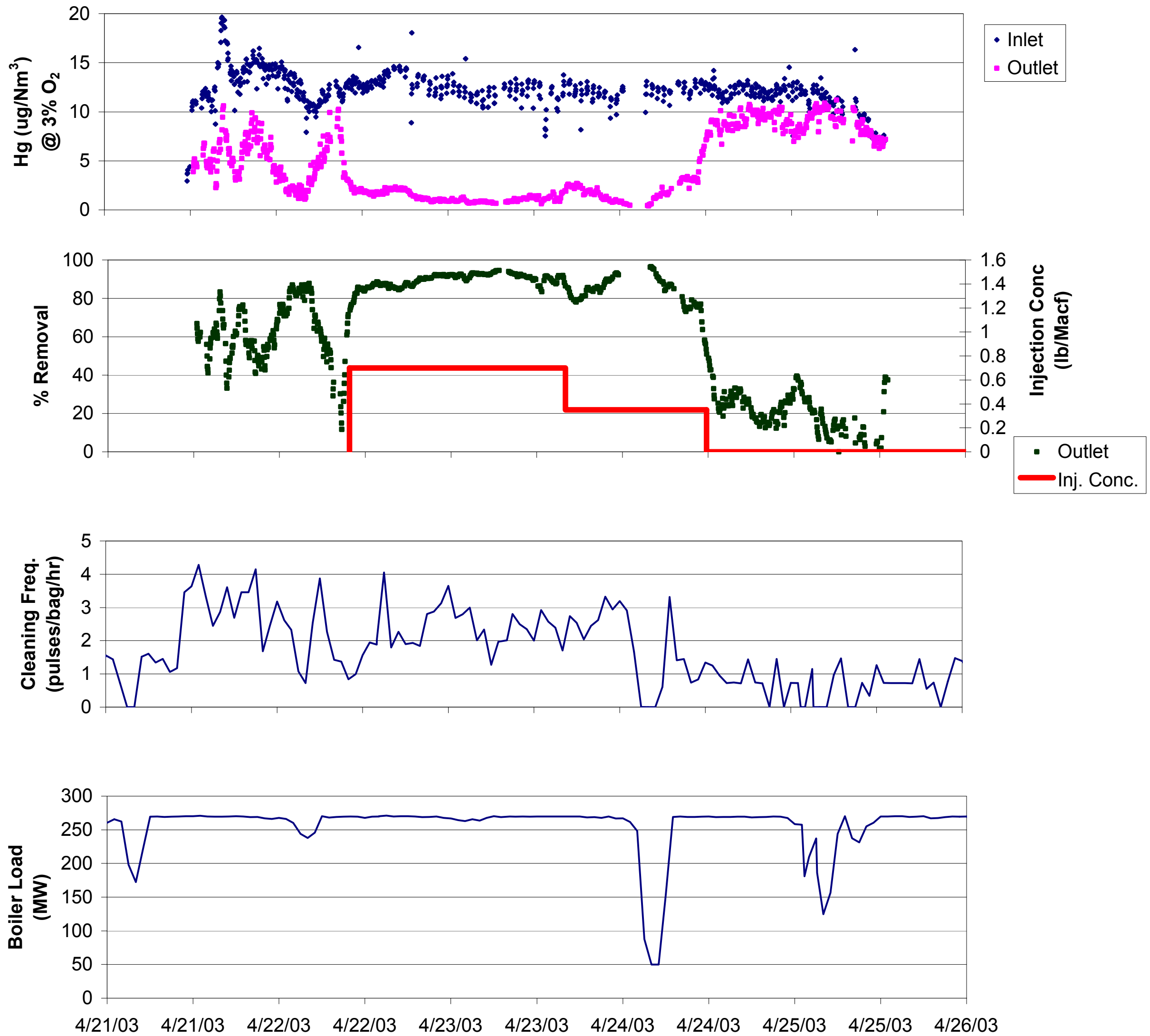

Figure 3. Unit 3B performance and operating trends during the week of April 21 (with carbon injection).

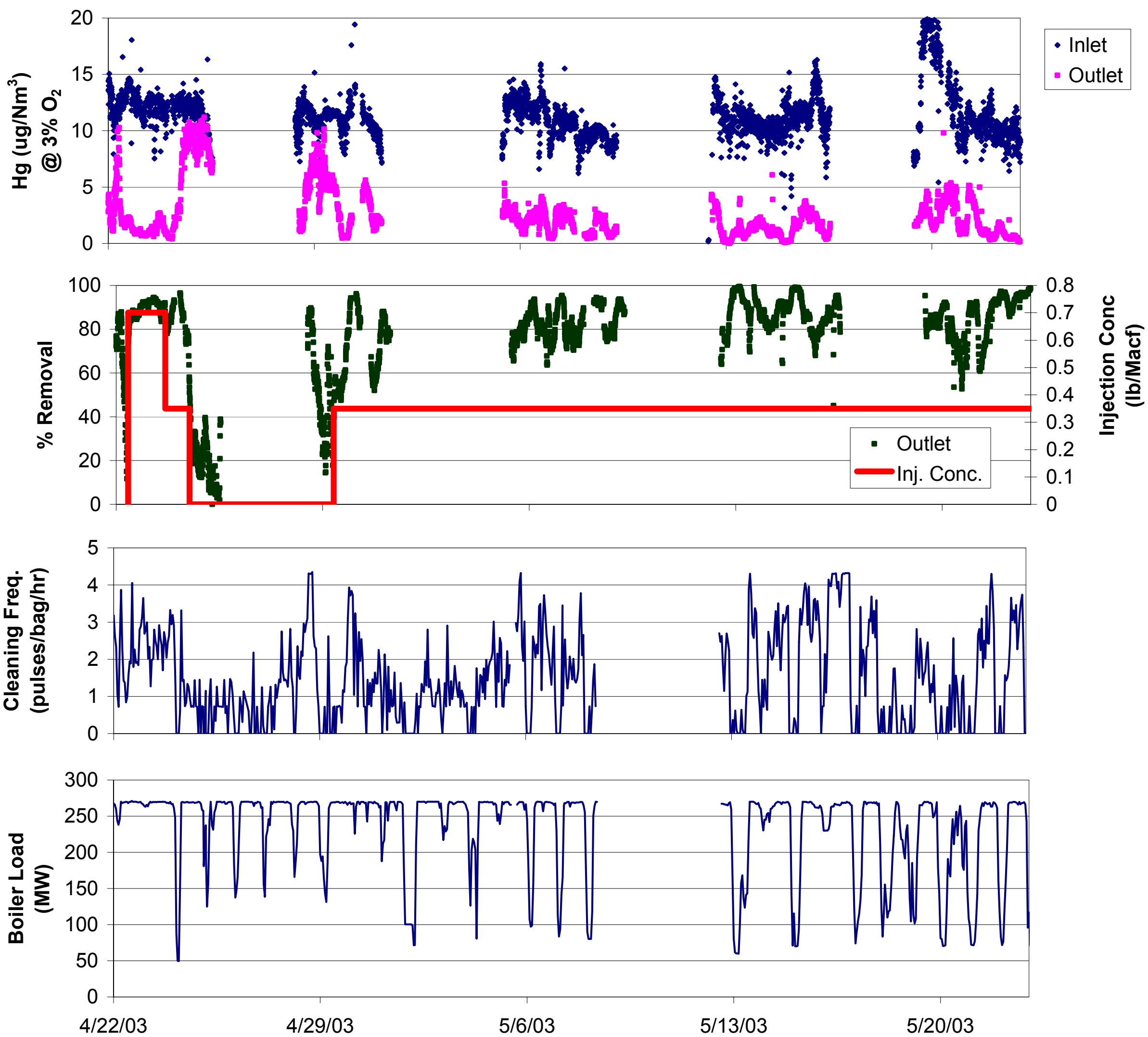

Figure 4. Unit 3B performance and operating trends during Optimization Period 1, April 22 – May 23.

Ash and Coal Measurements

During Optimization Period 1, coal samples were collected daily during the week and ash samples were collected periodically from both the A- and B-side COHPAC hoppers and from the hot-side ESP hopper. A complete list of samples collected during this period can be found in the Appendix.

Baseline Test Period 2 (May 28 – June 25)

On May 22 there was a team meeting at the Omni Hotel in Washington, DC. The meeting was planned to take advantage of many team members being in Washington for the Mega Symposium. At this meeting, results were presented from several weeks of operation at an injection rate of 10 lbs/h (0.35 lb/Macf). The injection rate was limited by high baseline COHPAC frequency. Mercury removal varied between 60 and 90%. The immediate action items from the meeting were:

- Continue investigating the cause of the higher than historic cleaning frequency.
  - Can anything be changed to improve this condition?
- Determine whether moving to A-side will provide better test conditions.
  - Stop carbon injection on B-side to gather performance comparison between A- and B-sides.
  - Measure mercury on A-side.

On May 27 carbon injection was shut down to begin this second baseline period.

Unit 3 and ESP Performance

Mark Berry from Southern Company was on-site the week of June 2 evaluating ESP performance and the week of June 16 trying to implement a revised ESP control logic in the back fields. This unit does not have a dedicated data-logging computer for the electrical data, so it was difficult to monitor the effect on performance from changes in control logic. A new control system with real-time and historical ESP performance trending is scheduled to be installed and operational by the end of July. System troubleshooting will restart once this system is in place.

Unit 3 B-side vs. A-side Performance Comparison

COHPAC Performance

Carbon injection was stopped on May 27. Pressure drop, cleaning frequency and inlet loading are the primary variables for comparison. To help with this evaluation, the BHA Particulate Monitor was reinstalled on A-side (it had been sent out for repair), and maintenance was performed on both A- and B-side instruments. Figure 5 presents cleaning frequency (pulses/bag/hour) and inlet loading during full-load boiler operation (boiler load > 270MW) for A- and B-side from June 1 through June 11. These data show that A- and B-sides are performing similarly in both cleaning frequency and inlet loading. When the unit is at full load, cleaning frequency varies from less than one (1) to continuous cleaning (4.3 p/b/h). Average values during this period for these primary variables are presented in Table 3. These data show very little difference between the two sides. B-side cleaning was slightly higher at 1.8 versus 1.6 p/b/h. It is important to note that even though the average frequency is less than 2 p/b/h, both units have periods of continuous cleaning without activated carbon injection. It is also worth noting that the maximum allowable cleaning frequency during the Phase I tests was 1.5 p/b/h and both sides are at or above this rate at baseline conditions.

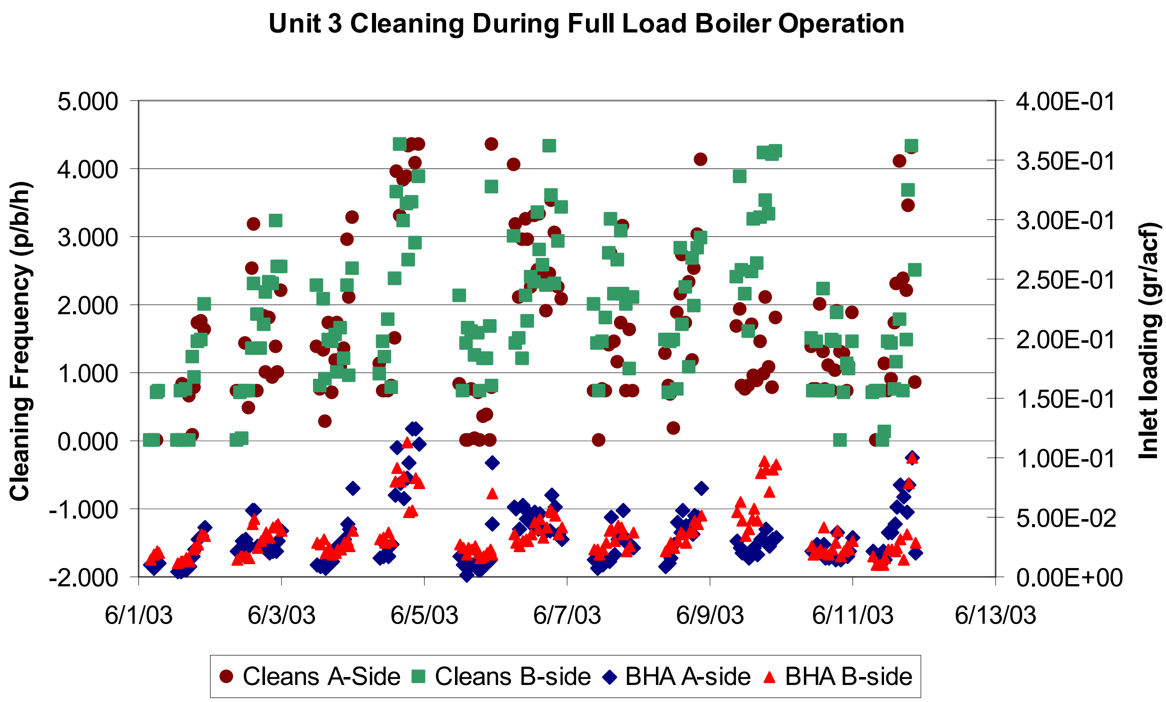

Figure 5. Comparison of A- and B-side full-load cleaning frequency and inlet loading with no carbon injection. Gaston Unit 3 June 2003.

Table 3: Average Values COHPAC Unit 3B: May 31 – June 12, 2003

Side	Cleaning Frequency (Pulses/bag/hour)	Inlet loading (gr/acf)	A/C Ratio (ft/min)	Pressure Drop (inches H_2O)
A	**1.6**	**0.033**	**8.2**	**7.3**
B	**1.8**	**0.036**	**8.1**	**7.2**

Graphs comparing cleaning frequency to inlet particulate loading (no injection) over a two-week period for both A- and B-side at full-load conditions were developed. As would be expected, there is a direct, linear correlation between the two. In the Phase I tests we developed a curve of cleaning frequency and activated carbon injection concentration. It was noted at the time that the activated carbon causes a higher pressure for the same amount of ash. The trend lines from all of these data are plotted in Figure 6. If we set the maximum carbon injection concentration at 1.0 lbs/Macf, the addition in grain loading is 0.0035 gr/acf and the predicted increase in cleaning frequency is 1 p/b/h. This can be seen in Figure 6 as the vertical line extending up from 0.0035 gr/acf. The final line in this figure is the predicted relationship between cleaning frequency and inlet loading when carbon is injected at 1 lb/Macf.

Following the same logic and using the data from Table 3, the average cleaning frequency during the comparison period on B-side was 1.8 p/b/h. Adding carbon at 1 lb/Macf would increase this to at least 2.8 p/b/h.

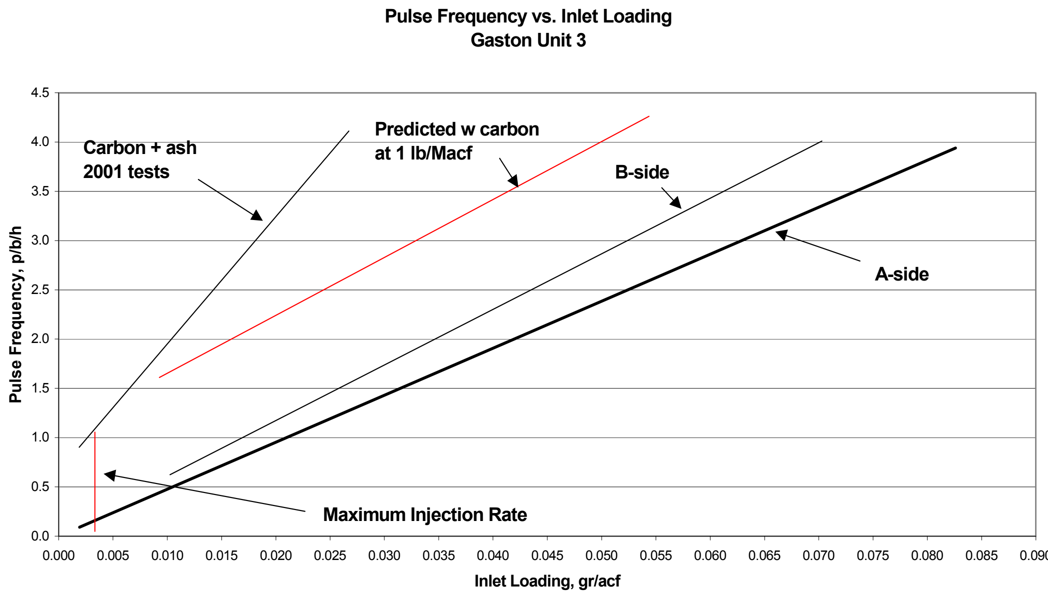

Figure 6. Comparison of A- and B-side full-load cleaning frequency and inlet loading with no carbon injection. Gaston Unit 3 June 2003.

Mercury S-CEM Measurements

A second mercury detector was installed at Gaston to gather simultaneous mercury measurements on A- and B-side and to begin measuring speciated vapor-phase mercury. Figure 7 presents total vapor-phase mercury concentrations at the inlet and outlet of B-side COHPAC and the outlet of A-side COHPAC during the week of June 2. These data show:

- that A outlet was often equal to the B inlet.
- there were times when A was also showing mercury removal, similar to what is seen on B-side.
- Although cleaning frequency is not shown in this figure, mercury removal was higher on A-side during periods of higher cleaning frequency.

Speciated mercury was measured on A-outlet. Preliminary data show that most (>90%) of the mercury is in the oxidized form.

Figure 8 presents data from Baseline Period 2, May 28 through June 25.

- Similar to Baseline Period 1, outlet mercury varied significantly, between nominally 1 and 16 μg/Nm3.
- Removal efficiency during this period varied between 0 and 90%.

- Periods with higher grain loading and higher cleaning frequency correlate with periods of higher, baseline mercury removal.

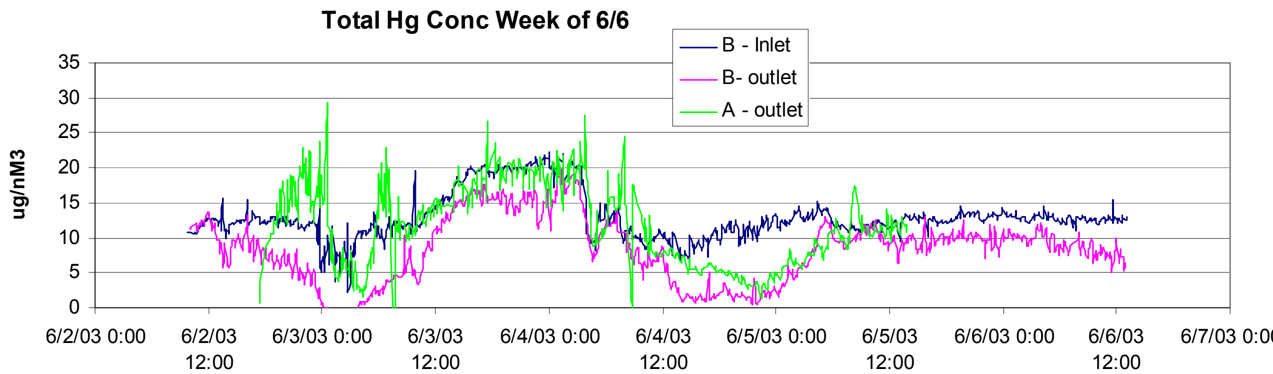

Figure 7. Mercury measurements week of June 6, 2003. Measurement locations were inlet and outlet of 3B COHPAC and outlet of 3A.

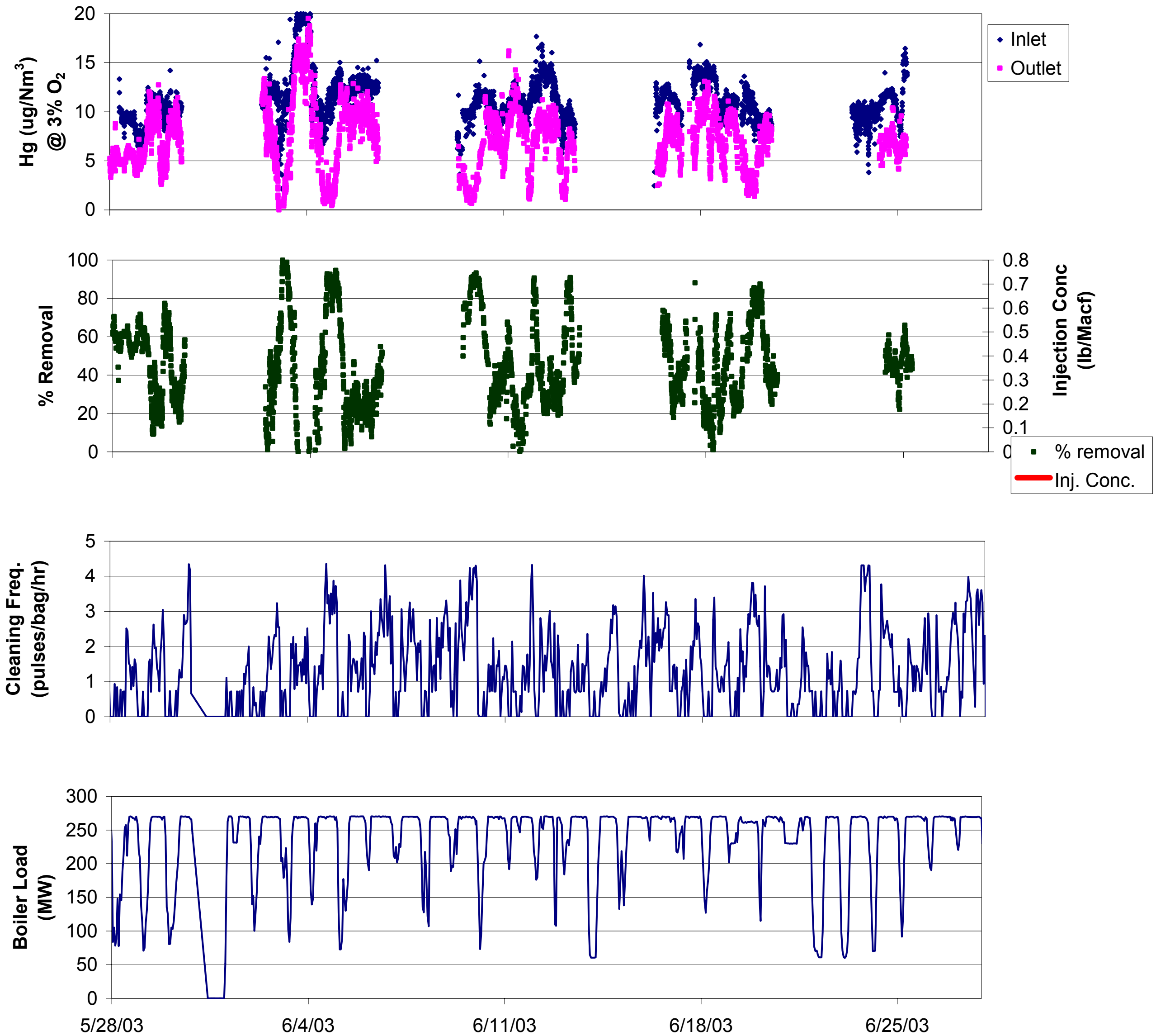

Figure 8. Unit 3B performance and operating trends during Baseline period 2.

Ash and Coal Measurements

During Baseline Period 2 testing, coal samples were collected daily during the week and ash samples were collected periodically from both the A- and B-side COHPAC hoppers and from the hot-side ESP hopper. A complete list of samples collected during this period can be found in the Appendix.

To assist with timely analysis and troubleshooting, a Hot Foil LOI analyzer was leased from FERCO Inc. This should arrive in early July.

Analysis and Recommendations from Baseline Period 2

Analysis from Baseline Period 2

Data collected over this period show that:

1. A- and B-side COHPAC baghouses are performing similarly in terms of cleaning frequency and pressure drop; and
2. A- and B-side COHPAC baghouses show similar mercury removal trends.

Moving to A-side requires the following:

- Install carbon injection ports
- Extend main carbon injection hose
- Relocate distribution manifold, flanges and lances
- Relocate inlet and outlet sampling probes and equipment

Most of these would take relatively little time, except for the installation of new ports.

We also investigated the possibility of controlling injection rate based on a feedback signal from the BHA particle analyzer (inlet particulate loading). With the help of Ray Wilson (a Southern Company contractor), it appeared that this was possible and steps were taken to implement this control logic.

Recommendations from Baseline Period 2

- Because there is not much difference in performance between the two sides, do not change over to A-side at this time.
- Implement a new carbon injection control logic based on feedback from the BHA particle analyzer.
- Sufficient comparison data have been collected, so restart carbon injection as soon as possible. (If conditions are such that COHPAC performance appears to be significantly impacted by carbon injection, the system may be periodically shut down.)

CONCLUSION

None this reporting period.

REFERENCES

None this reporting period.

LIST OF ACRONYMS AND ABBREVIATIONS

ACI	Activated Carbon Injection
APC	Alabama Power Company
COHPAC	Compact Hybrid Particulate Collector
DOE	Department of Energy
ESP	Electrostatic Precipitator
kW	Kilowatts
MW	Megawatts
NETL	National Energy Technology Laboratory
O&M	Operating and Maintenance
S-CEM	Semi-Continuous Emission Monitor
TCLP	Toxicity Characteristic Leaching Procedure

APPENDIX

Database of Collected Samples

Samples collected during Baseline Period 1 (March 24 – April 21, 2003)

Sample ID	Unit Number	Plant Name	Date/Time	Project Number	Sampled By	Sample Location	Sample Type	Comments
GAS00174	Unit 3	Gaston	3/23/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00175	Unit 3	Gaston	3/24/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00176	Unit 3	Gaston	3/25/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00177	Unit 3	Gaston	3/27/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00178	Unit 3	Gaston	3/28/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00179	Unit 3	Gaston	3/29/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00180	Unit 3	Gaston	3/30/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00181	Unit 3	Gaston	3/31/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00182	Unit 3	Gaston	4/1/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00183	Unit 3	Gaston	4/2/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00184	Unit 3	Gaston	3/24/03 10:00 AM	7101	CVL	Baghouse B side	Ash	5 gallon bucket
GAS00185	Unit 3	Gaston	3/24/03 10:00 AM	7101	CVL	Baghouse A side	Ash	1 lt. Bottle
GAS00186	Unit 3	Gaston	3/25/03 2:00 PM	7101	CVL	Baghouse B side	Ash	5 gallon bucket
GAS00187	Unit 3	Gaston	3/26/03 10:00 AM	7101	Sdavis	Baghouse B side	Ash	5 gallon bucket West outlet
GAS00188	Unit 3	Gaston	3/27/03 1:00 PM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle West outlet
GAS00189	Unit 3	Gaston	3/27/03 1:00 PM	7101	Sdavis	Baghouse B side	Ash	West center
GAS00190	Unit 3	Gaston	3/27/03 1:00 PM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle West inlet
GAS00191	Unit 3	Gaston	3/27/03 1:00 PM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle East outlet
GAS00192	Unit 3	Gaston	3/27/03 1:00 PM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle East center
GAS00193	Unit 3	Gaston	3/27/03 1:00 PM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle East inlet
GAS00194	Unit 3	Gaston	3/28/03 1:00 PM	7101	Sdavis	Baghouse B side	Ash	5 gallon bucket West outlet
GAS00195	Unit 3	Gaston	3/28/03 1:00 PM	7101	CVL	hot side ESP	Ash	1 lt. Bottle
GAS00196	Unit 3	Gaston	3/31/03 11:00 AM	7101	Sdavis	Baghouse B side	Ash	5 gallon bucket West outlet
GAS00197	Unit 3	Gaston	4/1/03 9:30 AM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle West outlet
GAS00198	Unit 3	Gaston	4/1/03 9:30 AM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle West center
GAS00199	Unit 3	Gaston	4/1/03 9:30 AM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle West inlet
GAS00200	Unit 3	Gaston	4/1/03 9:30 AM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle East outlet
GAS00201	Unit 3	Gaston	4/1/03 9:30 AM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle East center

Sample ID	Unit Number	Plant Name	Date/Time	Project Number	Sampled By	Sample Location	Sample Type	Comments
GAS00202	Unit 3	Gaston	4/1/03 9:30 AM	7101	Sdavis	Baghouse B side	Ash	1 lt. Bottle East inlet
GAS00203	Unit 3	Gaston	4/2/03 8:00 AM	7101	Sdavis	Baghouse B side	Ash	5 gallon bucket Weat outlet
GAS00204	Unit 3	Gaston	4/2/03 9:00 AM	7101	Sdavis	hot side ESP	Ash	1 lt. Bottle
GAS00205	Unit 3	Gaston	4/2/03 3:30 PM	7101	Sdavis	Baghouse A side	Ash	1 lt. Bottle East outlet
GAS00206	Unit 3	Gaston	4/3/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00207	Unit 3	Gaston	4/4/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00208	Unit 3	Gaston	4/3/03 1:40 PM	7101	Sdavis	Baghouse B side	Ash	5 gallon bucket East outlet
GAS00209	Unit 3	Gaston	4/4/03 11:30 AM	7101	Sdavis	Baghouse B side	Ash	5 gallon bucket East inlet
GAS00210	Unit 3	Gaston	4/7/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00211	Unit 3	Gaston	4/8/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00212	Unit 3	Gaston	4/9/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00213	Unit 3	Gaston	4/10/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00214	Unit 3	Gaston	4/11/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00215	Unit 3	Gaston	4/14/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00216	Unit 3	Gaston	4/15/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00217	Unit 3	Gaston	4/7/03 11:00 AM	7101	PB	Baghouse B side	Ash	1 lt. Bottle East center
GAS00218	Unit 3	Gaston	4/9/03 2:30 PM	7101	PB	Baghouse B side	Ash	5 gallon bucket 50% East inlet 50% East center
GAS00219	Unit 3	Gaston	4/10/03 2:00 PM	7101	PB	Hot side ESP	Ash	1 lt. Bottle East center
GAS00220	Unit 3	Gaston	4/15/03 3:30 PM	7101	PB	Baghouse B side	Ash	1 lt. Bottle West outlet
GAS00221	Unit 3	Gaston	4/15/03 2:30 PM	7101	PB	Hotside ESP	Ash	1 lt. Bottle Inlet row center
GAS00222	Unit 3	Gaston	4/16/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00223	Unit 3	Gaston	4/17/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00224	Unit 3	Gaston	4/17/03 12:00 PM	7101	CVL	Hotside ESP	Ash	1 lt. Bottle Inlet row center
GAS00225	Unit 3	Gaston	4/17/03 12:30 PM	7101	CVL	Baghouse B side	Ash	1 lt. Sample Outlet West hopper
GAS00226	Unit 3	Gaston	4/18/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab

Samples collected during Optimization Period 1 (April 21 – May 27, 2003)

Sample ID	Unit Number	Plant Name	Date/Time	Project Number	Sampled By	Sample Location	Sample Type	Comments
GAS00227	Unit 3	Gaston	4/21/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00228	Unit 3	Gaston	4/21/03 2:30 PM	7101	CVL	Hotside ESP	Ash	1 lt. Bottle Inlet row center
GAS00229	Unit 3	Gaston	4/21/03 2:45 PM	7101	PB	Baghouse B side	Ash	1 lt. Sample Outlet East hopper
GAS00230	Unit 3	Gaston	4/22/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00231	Unit 3	Gaston	4/23/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00232	Unit 3	Gaston	4/24/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00233	Unit 3	Gaston	4/25/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00234	Unit 3	Gaston	4/23/03 11:15 AM	7101	PB	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00235	Unit 3	Gaston	4/23/03 11:00 AM	7101	PB	Baghouse B side	Ash	1 lt. Sample Outlet East hopper
GAS00236	Unit 3	Gaston	4/23/03 11:00 AM	7101	PB	Baghouse B side	Ash	1 lt. Sample Outlet East hopper
GAS00237	Unit 3	Gaston	4/23/03 9:30 AM	7101	CVL	Hotside ESP	Ash	1 lt. Sample Inlet center hopper
GAS00238	Unit 3	Gaston	4/23/03 11:00 AM	7101	PB	Baghouse B side	Ash	5 Gal. bucket Sample Outlet West hopper
GAS00239	Unit 3	Gaston	4/24/03 10:45 AM	7101	PB	Baghouse B side	Ash	5 Gal. Sample 50% ea Center E & Outlet E
GAS00240	Unit 3	Gaston	4/28/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00241	Unit 3	Gaston	4/29/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00242	Unit 3	Gaston	4/30/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00243	Unit 3	Gaston	5/1/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00244	Unit 3	Gaston	5/2/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00245	Unit 3	Gaston	5/3/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00246	Unit 3	Gaston	5/4/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00247	Unit 3	Gaston	5/5/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00248	Unit 3	Gaston	4/28/03 1:00 PM	7101	CVL	Baghouse B side	Ash	1 lt. Sample Center East hopper
GAS00249	Unit 3	Gaston	5/1/03 9:10 AM	7101	PB	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00250	Unit 3	Gaston	5/1/03 9:10 AM	7101	PB	Baghouse A side	Ash	1 lt. Sample Inlet East hopper
GAS00251	Unit 3	Gaston	5/1/03 9:30 AM	7101	CVL	Hotside ESP	Ash	1 lt. Sample Inlet center hopper
GAS00252	Unit 3	Gaston	5/6/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00253	Unit 3	Gaston	5/7/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab

Sample ID	Unit Number	Plant Name	Date/Time	Project Number	Sampled By	Sample Location	Sample Type	Comments
GAS00254	Unit 3	Gaston	5/8/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00255	Unit 3	Gaston	5/9/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00256	Unit 3	Gaston	5/8/03 3:00 PM	7101	PB	Baghouse A side	Ash	1 lt. Sample Inlet West hopper
GAS00257	Unit 3	Gaston	5/8/03 3:00 PM	7101	PB	Baghouse B side	Ash	1 lt. Sample Outlet East hopper
GAS00258	Unit 3	Gaston	5/8/03 3:15 PM	7101	PB	Hotside ESP	Ash	1 lt. Third Row East
GAS00259	Unit 3	Gaston	5/12/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00260	Unit 3	Gaston	5/13/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00261	Unit 3	Gaston	5/14/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00262	Unit 3	Gaston	5/15/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00263	Unit 3	Gaston	5/16/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00264	Unit 3	Gaston	5/19/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00265	Unit 3	Gaston	5/14/03 12:45 PM	7101	PB	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00266	Unit 3	Gaston	5/14/03 12:40 PM	7101	PB	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00267	Unit 3	Gaston	5/14/03 1:30 PM	7101	PB	Hotside ESP	Ash	1 lt. Inlet Center
GAS00268	Unit 3	Gaston	5/20/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00269	Unit 3	Gaston	5/21/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00270	Unit 3	Gaston	5/22/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00271	Unit 3	Gaston	5/23/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00272	Unit 3	Gaston	5/21/03 2:00 PM	7101	PB	Baghouse A side	Ash	1 lt. Sample Inlet West hopper
GAS00273	Unit 3	Gaston	5/21/03 2:00 PM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00274	Unit 3	Gaston	5/21/03 2:20 PM	7101	PB	Hotside ESP	Ash	1 lt. Inlet Center

Samples collected during Baseline Period 2 (May 28 – June 25, 2003)

Sample ID	Unit Number	Plant Name	Date/Time	Project Number	Sampled By	Sample Location	Sample Type	Comments
GAS00275	Unit 3	Gaston	5/28/03 10:10 AM	7101	TT	Baghouse A side	Ash	1 lt. Sample Inlet West hopper
GAS00276	Unit 3	Gaston	5/28/03 10:10 AM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00277	Unit 3	Gaston	5/28/03 11:00 AM	7101	TT	Hotside ESP	Ash	1 lt. Inlet Center
GAS00278	Unit 3	Gaston	5/28/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00279	Unit 3	Gaston	5/30/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00280	Unit 3	Gaston	6/2/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00281	Unit 3	Gaston	6/4/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00282	Unit 3	Gaston	6/5/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00283	Unit 3	Gaston	6/6/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00284	Unit 3	Gaston	6/4/03 3:00 PM	7101	PB	Baghouse A side	Ash	1 lt. Sample Inlet West hopper
GAS00285	Unit 3	Gaston	6/4/03 3:00 PM	7101	PB	Baghouse B side	Ash	1 lt. Sample Middle West hopper
GAS00286	Unit 3	Gaston	6/4/03 3:15 PM	7101	PB	Hotside ESP	Ash	1 lt. Inlet Center
GAS00287	Unit 3	Gaston	6/5/03 2:30 PM	7101	TT	Baghouse A side	Ash	1 lt. Sample Inlet West hopper
GAS00288	Unit 3	Gaston	6/9/03 1:30 PM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00289	Unit 3	Gaston	6/5/03 2:30 PM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00290	Unit 3	Gaston	6/5/03 3:00 PM	7101	TT	Hotside ESP	Ash	1 lt. Inlet Center
GAS00291	Unit 3	Gaston	6/6/03 1:00 PM	7101	TT	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00292	Unit 3	Gaston	6/6/03 1:00 PM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00293	Unit 3	Gaston	6/6/03 2:00 PM	7101	TT	Hotside ESP	Ash	1 lt. Inlet Center
GAS00294	Unit 3	Gaston	6/9/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00295	Unit 3	Gaston	6/10/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00296	Unit 3	Gaston	6/11/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00297	Unit 3	Gaston	6/12/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00298	Unit 3	Gaston	6/11/03 11:45 AM	7101	TT	Baghouse A side	Ash	1 lt. Sample Inlet West hopper
GAS00299	Unit 3	Gaston	6/11/03 11:40 AM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00300	Unit 3	Gaston	6/11/03 2:00 PM	7101	TT	Hotside ESP	Ash	1 L Inlet Center
GAS00301	Unit 2	Gaston	6/9/03 1:05 PM	7101	TT	Baghouse A side	Ash	1 lt. Sample Center East hopper

Sample ID	Unit Number	Plant Name	Date/Time	Project Number	Sampled By	Sample Location	Sample Type	Comments
GAS00302	Unit 3	Gaston	6/12/03 11:50 AM	7101	TT	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00303	Unit 3	Gaston	6/12/03 11:45 AM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00304	Unit 3	Gaston	6/13/03 9:50 AM	7101	TT	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00305	Unit 3	Gaston	6/13/03 11:50 AM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00306	Unit 3	Gaston	6/13/03 10:33 AM	7101	TT	Hotside ESP	Ash	1 lt. Inlet Center
GAS00307	Unit 3	Gaston	6/13/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00308	Unit 3	Gaston	6/3/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00309	Unit 3	Gaston	6/16/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00310	Unit 3	Gaston	6/17/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00311	Unit 3	Gaston	6/18/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00312	Unit 3	Gaston	6/19/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00313	Unit 3	Gaston	6/19/03 1:30 PM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00314	Unit 3	Gaston	6/19/03 1:45 PM	7101	TT	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00315	Unit 3	Gaston	6/18/03 3:05 PM	7101	TT	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00316	Unit 3	Gaston	6/18/03 3:30 PM	7101	TT	Hotside ESP	Ash	1 lt. Inlet Center
GAS00317	Unit 3	Gaston	6/17/03 10:20 PM	7101	TT	Baghouse A side	Ash	1 lt. Sample Center West hopper
GAS00318	Unit 3	Gaston	6/17/03 10:18 PM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00319	Unit 3	Gaston	6/18/03 3:00 PM	7101	TT	Baghouse B side	Ash	1 lt. Sample Center West hopper
GAS00320	Unit 3	Gaston	6/19/03 2:15 PM	7101	TT	Hotside ESP	Ash	1 lt. Inlet Center
GAS00321	Unit 3	Gaston	6/17/03 11:00 PM	7101	TT	Hotside ESP	Ash	1 lt. Inlet Center
GAS00322	Unit 3	Gaston	6/20/03 3:35 PM	7101	TT	Baghouse A side	Ash	1 lt. Center west
GAS00323	Unit 3	Gaston	6/20/03 3:30 PM	7101	TT	Baghouse B side	Ash	1 lt. Center west
GAS00324	Unit 3	Gaston	6/20/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00325	Unit 3	Gaston	6/23/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00326	Unit 3	Gaston	6/24/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00327	Unit 3	Gaston	6/25/03 12:00 AM	7101	Plant	Coal belt / Coal lab	Coal	Sample riffled and prepared by plant coal lab
GAS00328	Unit 3	Gaston	6/23/03 4:20 PM	7101	TT	Baghouse A side	Ash	1 lt. Center west
GAS00329	Unit 3	Gaston	6/25/03 2:30 PM	7101	TT	Baghouse B side	Ash	1 lt. Center west

Sample ID	Unit Number	Plant Name	Date/Time	Project Number	Sampled By	Sample Location	Sample Type	Comments
GAS00330	Unit 3	Gaston	6/23/03 4:30 PM	7101	TT	Hotside ESP	Ash	1 lt. Center Inlet
GAS00331	Unit 3	Gaston	6/24/03 3:05 PM	7101	TT	Baghouse B side	Ash	1 lt. Center west
GAS00332	Unit 3	Gaston	6/25/03 2:35 PM	7101	TT	Baghouse A side	Ash	1 lt. Center west
GAS00333	Unit 3	Gaston	6/24/03 3:00 PM	7101	TT	Baghouse A side	Ash	1 lt. Center west
GAS00334	Unit 3	Gaston	6/23/03 4:15 PM	7101	TT	Baghouse B side	Ash	1 lt. Center west
GAS00335	Unit 3	Gaston	6/25/03 2:45 PM	7101	TT	Hotside ESP	Ash	1 lt. Center Inlet